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Urethroplasty for Strictures After Phallic Reconstruction: A Single-Institution Experience

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Abstract

Background: Treatment recommendations for strictures after phalloplasty are lacking.
Objective: Our aim was to evaluate the outcome of urethroplasty for strictures after phalloplasty and to provide treatment recommendations based on this experience.
Design, setting, and participants: One hundred and eighteen urethroplasties were performed in 79 patients. Mean patient age was 37.6 yr. Mean follow-up was 39 mo.
Intervention: Different types of urethroplasty were used: meatotomy, Heineke-Mikulicz principle (HMP), excision and primary anastomosis (EPA), free graft urethroplasty (FGU), pedicled flap urethroplasty (PFU), two-stage urethroplasty (TSU), and perineostomy followed by urethral reconstruction (PUR).
Measurements: Stricture recurrence was defined as the need for additional instrumentation or surgery.
Results and limitations: Mean stricture length was 3.6 cm. Stricture location was at the meatus, phallic urethra, anastomosis, fixed part, and different locations in 18, 28, 48, 15, and 9 urethroplasties, respectively. Stricture recurrence was observed in 44 urethroplasties (41.12%). Stricture recurrence rate for meatotomy, HMP, EPA, FGU, PFU, TSU, and PUR was 25%, 42.11%, 42.86%, 50%, 40%, 30.3%, and 61.9%, respectively.
Conclusions: The main stricture location after phalloplasty is the anastomosis between the phallic and the fixed part. Urethroplasty for strictures after phalloplasty is associated with a relatively high recurrence rate.
Trial registration: EC UZG 2007/434.

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1. Introduction

Phalloplasty is a standard treatment for female-to-male transsexuals [1] and a possible treatment for patients with severe penile insufficiency [2,3]. A goal of phalloplasty is voiding in a standing position [4], which implicates the need for urethral lengthening procedures [5].

After phalloplasty, the urethra can be divided in (Fig. 1):

- Native urethra: female (transsexuals) or part of the male urethra (penile insufficiency) that is preserved.
- Fixed part (transsexuals): urethral lengthening with local tissues. Different techniques are possible [5–9].

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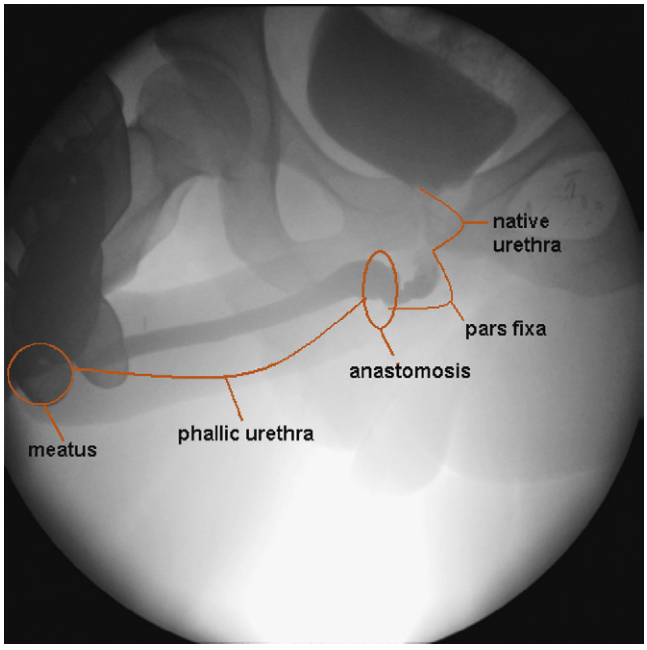

Fig. 1 – Anatomy of the reconstructed urethra in female-to-male transsexuals.

- Anastomotic part: connection between the phallic urethra and the remaining male urethra (penile insufficiency) or the fixed part (transsexuals).
- Phallic part: urethral lengthening inside the phallus. Different techniques are possible [5].
- Meatus: distal end of the phallic urethra where an anastomosis is made between the phallic urethra and the skin of the phallus.

Urethral strictures after phalloplasty are frequent [9–12], but treatment recommendations are lacking. Endoscopic incision has been proposed but is restricted to short and uncomplicated strictures [13]. Other strictures thus need urethroplasty, but <30 cases are described in the literature [11,12,14]. The Ghent University Hospital performs about 50 phalloplasties annually with a total now >450. We have gained a great deal of experience with urethroplasty for strictures after phalloplasty.

2. Materials and methods

We reviewed the clinical charts of patients who underwent urethroplasty for strictures after phalloplasty between April 1994 and May 2010. Data of 79 patients who underwent a total of 118 urethroplasties were collected (Fig. 2). The phallus was constructed with a radial forearm free flap or a pedicled anterolateral thigh flap in 73 and 6 patients, respectively. Figs. 3 and 4 show our construction technique of the fixed and phallic part of the urethra.

Three patients were men with severe penile insufficiency; the remaining 76 patients were female-to-male transsexuals. In the same period, internal urethrotomy was performed 47 times in 33 patients. Some of these patients also underwent urethroplasty, but data on internal urethrotomy were not included in the analysis. No previous intervention to treat a urethral stricture was done in 60 urethroplasties. In the remaining 58 urethroplasties, previous interventions included internal urethrotomy/dilations, urethroplasty, and urethroplasty/internal urethrotomy in 19, 20, and 19 cases, respectively.

The mean patient age was 37.6 yr (range: 19–65 yr). Mean follow-up was 39 mo (range: 2–195 mo). Preoperative evaluation included history taking, physical examination, uroflowmetry with residual volume measurement, urine culture, and urethrography. If urine was infected, antibiotics were administered following antibiogram. The distal extension of the stricture was identified using a large Béniqué catheter, ventrally incised, and opened further until healthy proximal urethra was

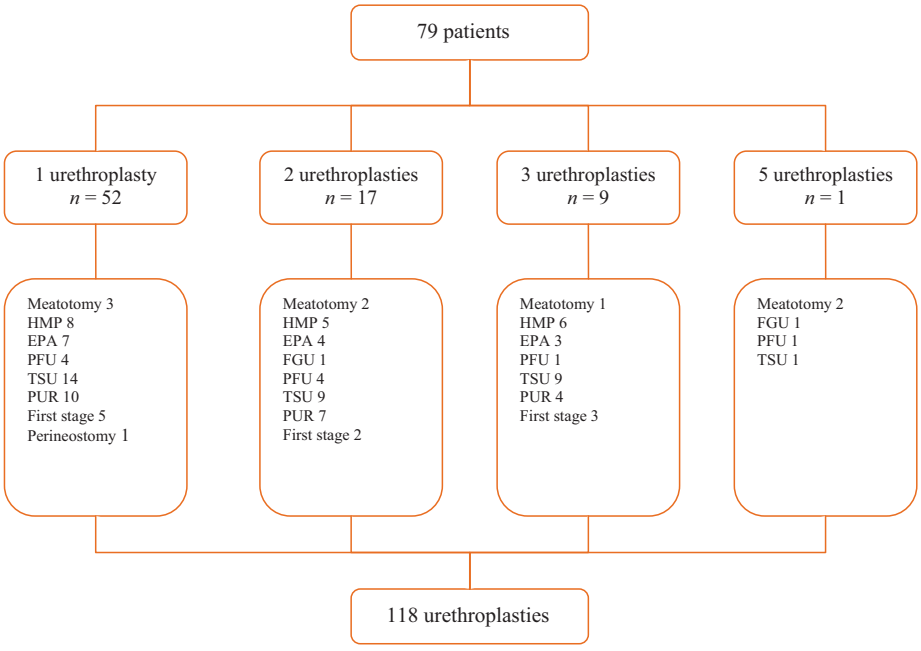

Fig. 2 – Distribution of urethroplasties per patient.
EPA = excision and primary anastomosis; FGU = free graft urethroplasty; HMP = Heineke-Mikulicz principle; PFU = pedicled flap urethroplasty; PUR = perineostomy followed by urethral reconstruction; TSU = two-stage urethroplasty.

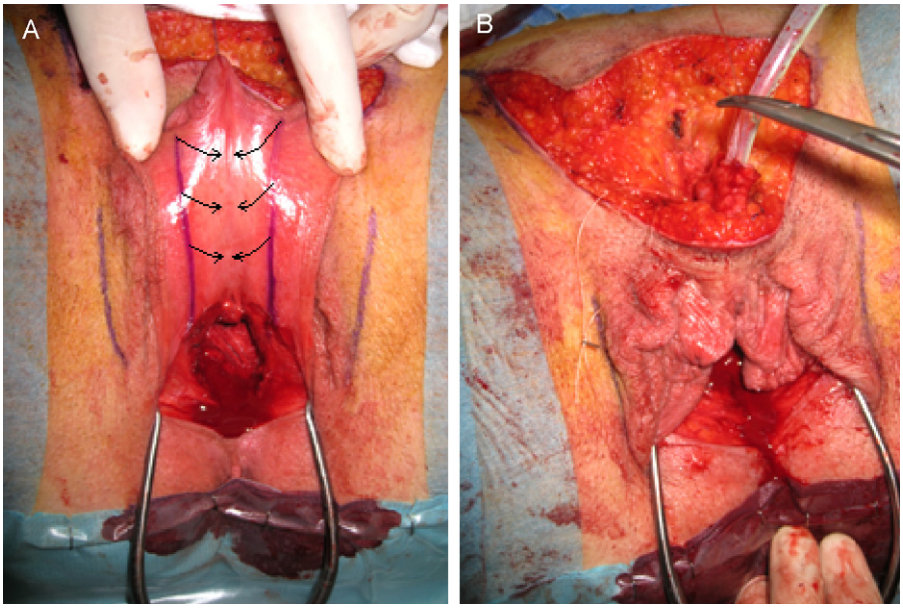

Fig. 3 – Construction of the fixed part of the urethra. (A) Tubularisation of the vestibular mucosal plate between the external orifice of the native urethra and the clitoral glans without the use of flaps of vaginal mucosa or labia minora. The clitoris and the fixed part of the urethra are released from the vulvar region, transposed to the prepubic area, and fixed at this location. (B) The anastomosis with the phallic part will take place at this site.

reached. After urethral reconstruction, a 16F silicone catheter was left in place for 2 wk and then removed if a voiding cystourethrography showed no or only minimal extravasation. In the case of significant extravasation, the catheter was maintained for an additional week and the voiding cystourethrography repeated.

Follow-up was done every 3 mo during the first year and annually thereafter. If a recurrence was suspected (clinically or on uroflowmetry: maximum flow rate <15 ml/s), a retrograde urethrography and urethroscopy was done. The need for further instrumentation or reoperation was considered a failure.

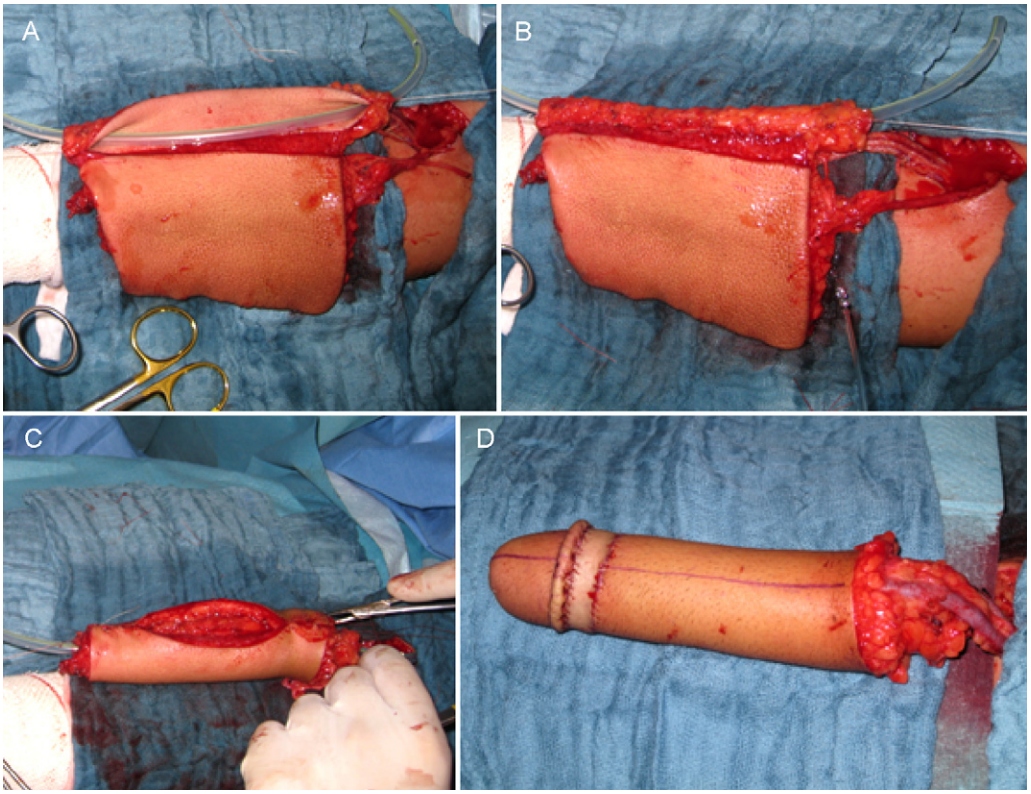

Fig. 4 – Construction of the phallic part of the urethra ("Chinese roll technique"). (A, B) At the radial forearm free flap, a skin island at the less hairy ulnar side of the flap is tubularised around an 18F catheter. (C) The remainder of the flap is wrapped around this tube. (D) At the distal end of the flap, a glans with meatus is created using an island flap and a free skin graft to mimic a glandular corona.

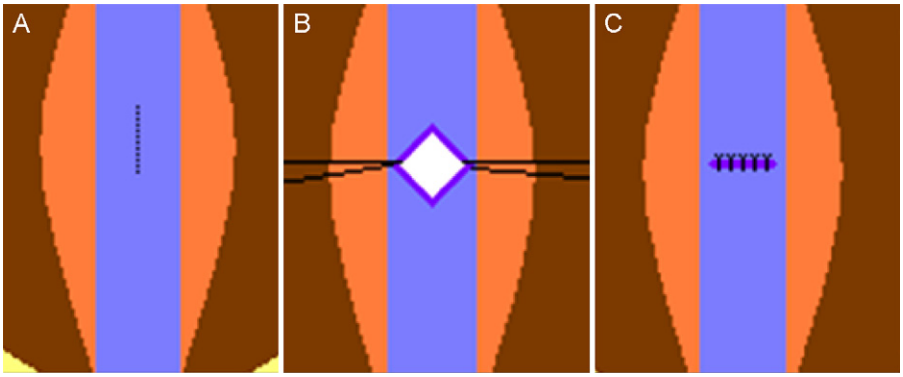

Fig. 5 – The Heineke-Mikulicz principle. (A) The strictured urethra is longitudinally incised at the ventral aspect. (B, C) Stay sutures are placed to facilitate transversal closure.

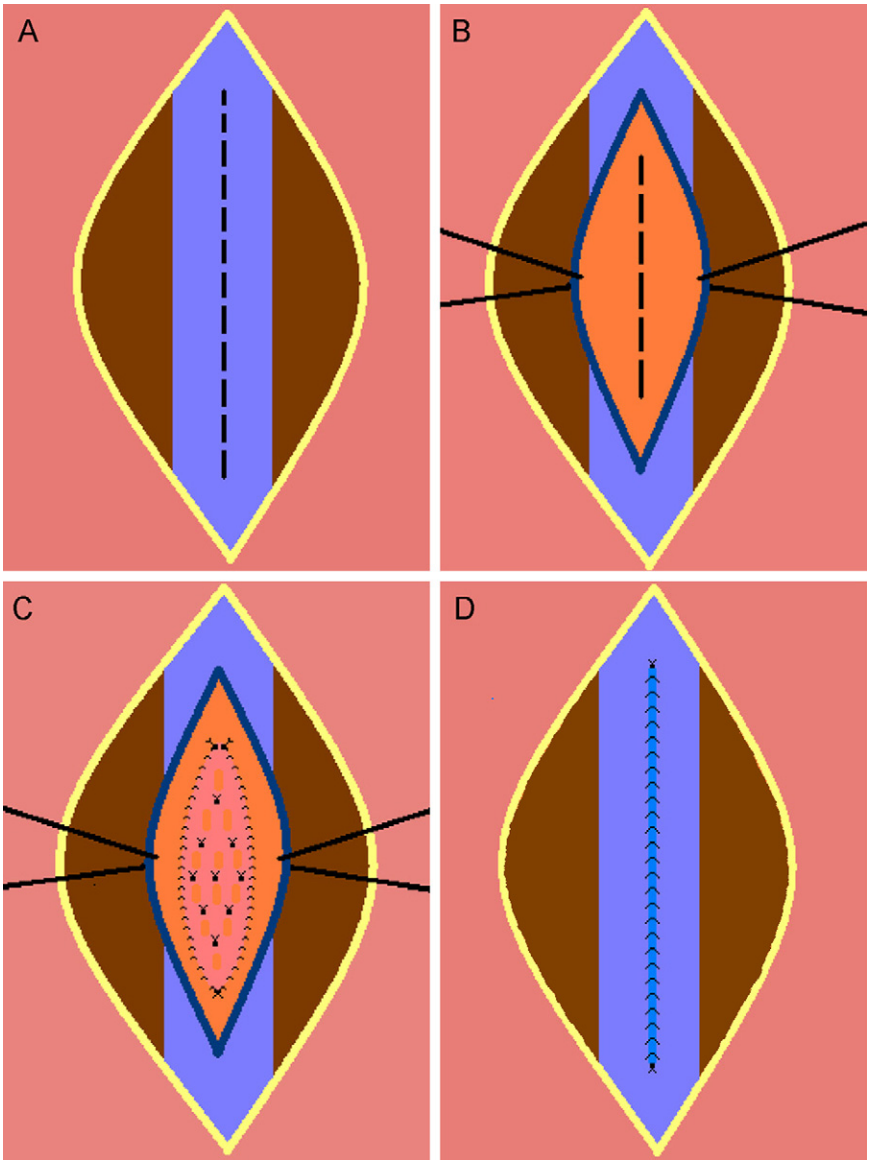

Fig. 6 – Technique of free graft urethroplasty. (A) The strictured urethra is opened at the ventral side. (B) An incision is made at the dorsal plate. (C) A meshed graft is used in a dorsal inlay fashion to augment the strictured urethra. (D) The ventral stricturotomy is then closed over a 16F urethral catheter.

If a urethral stricture was present, insertion of a penile prosthesis was postponed until the patient was free of urinary symptoms for at least 6 mo. If a penile prosthesis is already in place, care must be taken not to enter the "pseudo-capsule" containing the elements of the penile prosthesis. For this purpose, the stricture is opened ventrally: In the phallus, the cylinders are located dorsally to the urethra; at the anastomosis and at the fixed part, they are located laterally.

2.1. Surgical techniques

2.1.1. One-stage procedures

2.1.1.1. Meatotomy. A ventral incision at the meatus was made until healthy urethra was reached. The borders of the urethra were sutured against the borders of the skin.

2.1.1.2. Ventral longitudinal stricturotomy with transversal closure: the Heineke-Mikulicz principle. The ventral side of the stricture was incised longitudinally, and then the opened urethra was closed transversally (Fig. 5).

2.1.1.3. Excision and primary anastomosis. The fibrotic and strictured part was excised. The healthy urethral ends were mobilised somewhat, spatulated, and anastomosed.

2.1.1.4. Free graft urethroplasty. After opening the stricture, the dorsal urethral plate was incised and a graft was harvested (buccal mucosa or full-thickness skin graft) and sutured into this dorsal incision. Then the ventral incision of the urethra was reclosed (Fig. 6).

2.1.1.5. Pedicled flap urethroplasty. For phallic urethral strictures (seven patients), bilateral ventral longitudinal skin flaps of about 1 cm broad were created, mobilised, turned towards the opened stricture, and sutured. At the fixed part of the urethra (three patients), a 2-cm broad flap of "scrotal" skin was created, turned towards the opened stricture, and sutured.

2.1.2. Staged procedures

2.1.2.1. Two-stage urethroplasty. During the first stage, the stricture was opened and sutured against the borders of the skin incision (Fig. 7). After at least 3 mo and if the tissues were well healed, the second stage was performed: The borders of the marsupialised urethra were incised laterally enough to create a urethral tube, and the urethra was closed. If necessary, the dorsal urethral plate was resected and replaced or augmented with a skin graft (five cases).

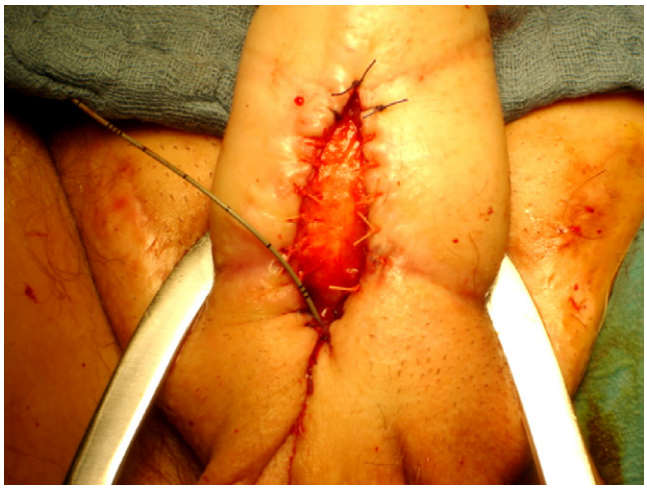

Fig. 7 – First stage of a two-stage urethroplasty. The strictured urethra is opened and the borders of the marsupialised urethra are sutured against the borders of the skin. In this case, a 4-cm-long stricture at the anastomosis and proximal phallic part was opened.

Fig. 8 – Technique of perineostomy. A midline perineal incision is made and the proximal part of the fixed part of the urethra is incised for about 4–5 cm. The borders of the opened urethral mucosa are sutured against the borders of the perineal skin. The native external urethral orifice is visible again.

2.1.2.2. Perineostomy followed by urethral reconstruction. In the first stage the perineostomy was constructed (Fig. 8). Urethral reconstruction (one of the techniques mentioned earlier) was done at least 3 mo later when the healing problems concerning the phalloplasty were resolved.

2.1.2.3. First stage of two-stage urethroplasty and definitive perineostomy. In 10 patients, the first stage of a two-stage urethroplasty (TSU) had already been performed. One patient was satisfied after the first stage of treatment for a stricture at the fixed part and wanted to keep this reconstruction as a definitive perineostomy. Because the urethra was not fully reconstructed over the whole length in these patients, data of these cases were removed from the analysis of the failure rate. These cases were included in the analysis for stricture location. Table 1 illustrates our current treatment algorithm.

Statistical analysis was done using MedCalc software (MedCalc, Mariakerke, Belgium). A t test was used for numerical data and a chi-square or Fisher exact test for categorical data. A p value <0.05 was considered statistically significant.

3. Results

Mean stricture length was 3.6 cm (range: 0.5–15 cm). Stricture location was at the meatus, phallic urethra,

Table 1 – In-house treatment algorithm for urethral strictures after phallic reconstruction according to stricture location and stricture characteristics

		Recommended	Possible
Meatus		Meatotomy	PFU TSU
Phallic urethra	Long	TSU	PFU FGU
	Short	TSU	HMP
Anastomosis	Fibrotic	EPA	TSU
	Nonfibrotic	HMP	
Fixed part	Long	TSU	PFU FGU
	Short	TSU	HMP EPA
Stricture <3 mo after phallic reconstruction/ associated with major phallic wound problems	–	PUR	–

EPA = excision and primary anastomosis; FGU = free graft urethroplasty; HMP = Heineke-Mikulicz principle; PFU = pedicled flap urethroplasty; PUR = perineostomy followed by urethral reconstruction; TSU = two-stage urethroplasty.

Table 2 – Stricture location and interval between phalloplasty and urethroplasty

	n (%)	Interval between phalloplasty and urethroplasty, mo
Meatus	18 (15.3)	24.1
Phallic part	28 (23.7)	35.3
Anastomosis	48 (40.7)	13.5
Fixed part	15 (12.7)	28.1
Multifocal	9 (7.6)	31.2

EPA = excision and primary anastomosis; FGU = free graft urethroplasty; HMP = Heineke-Mikulicz principle; PFU = pedicled flap urethroplasty; PUR = perineostomy followed by urethral reconstruction; TSU = two-stage urethroplasty.

anastomosis, fixed part, and different locations in 18, 28, 48, 15, and 9 urethroplasties, respectively (Table 2). The interval between phalloplasty and urethroplasty was the shortest for anastomotic strictures (not significant). Stricture recurrence was observed in 44 of 107 urethroplasties (41.12%). Fig. 9

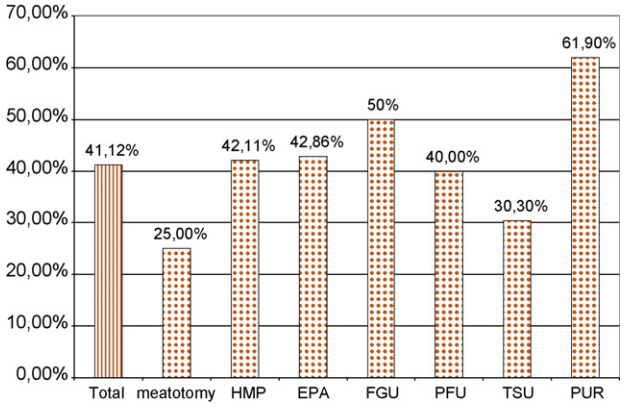

Fig. 9 – Failure rate overall and for the different types of urethroplasty. EPA = excision and primary anastomosis; FGU = free graft urethroplasty; HMP = Heineke-Mikulicz principle; PFU = pedicled flap urethroplasty; PUR = perineostomy followed by urethral reconstruction; TSU = two-stage urethroplasty.

shows the stricture recurrence subdivided for the different surgical techniques. Stricture recurrence was at the meatus, phallic urethra, anastomosis, fixed part, and different locations in 4, 11, 20, 6, and 3 patients, respectively. The failure rate was only significantly different between TSU and perineostomy followed by urethral reconstruction (PUR) ($p = 0.04$). First and reintervention urethroplasty had a recurrence rate of 40.28% and 42.86%, respectively ($p = 0.83$). Mean time to stricture recurrence after urethroplasty was 15 mo (range: 1–116 mo). Table 3 shows the stricture characteristics. Strictures treated by meatotomy, the Heineke-Mikulicz principle (HMP), and excision and primary anastomosis (EPA) were significantly shorter compared with other techniques. The interval between phalloplasty and urethral reconstruction for PUR was 3 mo on average, which was significantly shorter compared with all other groups.

4. Discussion

Urethral stricture formation is a major urologic complication of phalloplasty (incidence: 25–58%) [10–12]. This is the

Table 3 – Stricture characteristics for the different types of urethroplasty

	n	Length, cm	Follow-up, mo	Interval phalloplasty-urethroplasty, mo	Stricture location				
					Meatus, No. (%)	Phallic, No. (%)	Anastomosis, No. (%)	Fixed part, No. (%)	Multifocal, No. (%)
Meatotomy	8	1.1	70.4	39,5	8 (100)	0	0	0	0
HMP	19	1.1	44.1	22.4	0	1 (5.26)	15 (78.95)	3 (15.79)	0
EPA	14	1.3	34.9	10.9	0	0	13 (92.86)	1 (7.14)	0
FGU	2	6	101.5	86	0	1 (50)	0	1 (50)	0
PFU	10	3	52.2	16.6	5 (50)	2 (20)	2 (20)	1 (10)	0
TSU	33	5	24.8	28.6	5 (15.15)	9 (27.27)	7 (21.21)	5 (15.15)	7 (21.21)
PUR	21	4.9	48.1	3	0	10 (47.62)	9 (42.86)	0	2 (9.52)
First stage of TSU/perineostomy	11	5.9	14.4	48.5	0	5 (45.45)	2 (18.18)	4 (36.36)	0
Total	**118**	**3.6**	**39**	**23.5**	**18 (15.25)**	**28 (23.73)**	**48 (40.68)**	**15 (12.71)**	**9 (7.63)**

EPA = excision and primary anastomosis; FGU = free graft urethroplasty; HMP = Heineke-Mikulicz principle; PFU = pedicled flap urethroplasty; PUR = perineostomy followed by urethral reconstruction; TSU = two-stage urethroplasty.

reason why some surgeons are no longer reconstructing a neourethra [15,16].

4.1. Stricture location

The anastomosis between the fixed and phallic part of the urethra is the most important stricture location. This site is prone to fistulation in the early postoperative period. These fistulas for the most part close spontaneously but sometimes with excessive scarring, finally leading to stricture formation [10]. Another explanation is that they form due to relative ischemia at the anastomosis of tissues of native urethra to the reconstructed skin urethra, exacerbated by kinking at the neophallus base [12]. Furthermore, this site is a mucocutaneous junction that is prone to stricture formation [13]. Other important sites of stricture formation are at the phallic urethra and the meatus. These strictures are probably associated with phallic wound-healing problems and relative ischaemia inside the flap. At the meatus, a circular anastomosis is made of skin urethra with the skin of the flap, and contraction can lead to meatal stenosis. The fixed part of the urethra is the least affected. This part consists of well-vascularised native tissue surrounded by perineal muscles. Stricture formation there can occur due to perineal haematoma and dehiscence with wound infection or might be the consequence of a previous perineostomy.

4.2. Surgical techniques and treatment recommendations

Strictures after phallic reconstruction are difficult to treat for several reasons:

- Absence of corpus spongiosum leads to poor coverage of any urethral reconstruction.
- Absence of foreskin, elastic penile skin, and scrotal skin makes reconstruction with preputial, penile, and scrotal skin grafts or flaps impossible.
- Wound-healing problems associated with phalloplasty can lead to dense local scar tissue.

Despites these difficulties, the general principles of wound healing [17] and tissue transfer [18] also apply to urethral reconstruction after phalloplasty. Our results support the use of our in-house algorithm (Table 1) with the following treatment recommendations.

4.3. Meatotomy

Meatotomy is a reliable technique for short meatal strictures. The drawback is that a hypospadiac neomeatus is created but this is mostly well accepted by patients. If they are dissatisfied with the cosmetic results, a urethral reconstruction in a second stage is always possible.

4.4. Heineke-Mikulicz principle

HMP is an old concept in surgery that involves augmenting the diameter of a strictured segment. It can only be applied to very short strictures, approximately 1 cm long. It cannot be used in the case of dense fibrosis or a very narrow stricture. It is mostly used for anastomotic strictures but can also be applied to strictures at the phallic and the fixed part. Due to the absence of natural erections, no risk of chordee exists.

4.5. Excision and primary anastomosis

EPA is a possibility for short strictures up to 2–3 cm long. This is certainly our technique of choice in the case of excessive scar tissue, and we use it almost exclusively at the anastomotic region. In the case of such a stricture there is often dense scarring due to former problems such as wound dehiscence and fistula formation.

4.6. Free graft urethroplasty/pedicled flap urethroplasty

For longer strictures (>3 cm), a graft or a flap can be used, but indications are scarce. Free graft urethroplasty (FGU) can only be performed in the presence of a well-vascularised graft bed. Due to the absence of corpus spongiosum this is often not the case. Only two FGUs were performed: one at the fixed part, which is the only reliable well-vascularised part of the reconstructed urethra, and one at the phallic part with a well-healed phallus and well-vascularised suburethral fatty tissue. The graft was always placed in a dorsal inlay fashion: At the ventral side, vascularisation is often poor due to fibrosis related to previous fistulation or wound dehiscence. The coverage of the graft ventrally is poor, which could lead to graft failure. An alternative would be a dorsal onlay procedure (Barbagli procedure [19]), but dissection and rotation of this reconstructed urethra is certainly not evident. In PFU, we have used flaps based on the skin of the local reconstruction. A flap brings it own vascularisation to the strictured segment and can thus survive in the presence of dense fibrotic tissue. The scrotum in our transsexual patients is constructed by flaps of the labia majora [20], which is elastic skin and can be brought to strictures at the fixed part or at the anastomosis. For phallic urethral strictures, a longitudinal island skin flap was used. Because the pedicle cannot be mobilised as extensively as in ''normal'' urethral strictures, we were obliged to harvest this flap bilaterally to have a sufficient augmentation of the stricture. FGU and PFU are laborious procedures with somewhat poorer results compared with TSU. It is no longer our technique of first choice except when a patient, who has already undergone a multitude of surgical procedures, specifically asks for a one-stage procedure.

4.7. Two-stage urethroplasty

Two-stage urethroplasty is a simple and reliable technique with results better than the one-stage procedures (except meatotomy), although statistical significance has not been reached. It is preferred for long, complex, or refractory strictures.

4.8. Perineostomy followed by urethral reconstruction

PUR is a specific strategy used for strictures shortly after phalloplasty or in the case of major wound-healing problems. This is reflected by the mean time interval of 3 mo between phalloplasty and perineostomy. Shortly after phallic reconstruction, tissues are inflammatory, and an attempt for early urethral reconstruction is probably useless. In the case of major wound-healing problems (wound dehiscence, partial flap necrosis), we want to avoid further maceration of the flap and the wounds by passage of urine. The results of PUR were the worst. This probably does not mean the strategy itself is wrong, but it is probably explained by a urethral reconstruction that begins with tissues of poorer quality compared with the other cases.

4.9. Definitive perineostomy

In the case of recurrent/refractory strictures, the option of a definitive perineostomy must be discussed. It is often well accepted by mostly older native men with recurrent stricture disease [21]. But in our transsexual patients, voiding in a standing position is of high priority [10], and this solution was mostly not acceptable (except for one patient). The results of reintervention urethroplasty were not worse compared with first urethroplasty, which might suggest that several attempts to restore urethral patency can be performed.

The global success rate of 80–90% of major series on urethroplasty for "normal" urethral strictures [22–24] is higher than our global success rate of 58.88% for strictures after phallic reconstruction. It is our assumption that this lower success rate is due to the difficulties previously mentioned that are associated with the reconstructed urethra after phallic reconstruction. The limitation of this series is that it is a retrospective and purely descriptive analysis. It is possible that other strategies are equal or even better than these recommendations.

5. Conclusions

Main stricture location after phalloplasty is the anastomosis between the phallic part and the fixed part. Urethroplasty for strictures after phalloplasty is associated with a relative high recurrence rate. A broad variety of techniques is needed to handle each type of stricture. These techniques are based on the general principles of wound healing and tissue transfer.

Author contributions: Nicolaas Lumen had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Lumen.
Acquisition of data: Lumen, Goessaert, Hoebeke, Monstrey.
Analysis and interpretation of data: Lumen, Oosterlinck.
Drafting of the manuscript: Lumen.
Critical revision of the manuscript for important intellectual content: Oosterlinck, Hoebeke.
Statistical analysis: Lumen, Goessaert.
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Supervision: Hoebeke.
Other (specify): None.

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